**isl**

सर्वं सम्भाव्यते त्वयि

Instructions:

(i) There are two sections in each subject, i.e. Section-A & Section-B. You have to attempt all 35 questions from Section-A & only 10 questions from Section-B out of 15.

(ii) Each question carries 4 marks. For every wrong response 1 mark shall be deducted from the total score. Unanswered / unattempted questions will be given no marks.

(iii) Use blue/black ballpoint pen only to darken the appropriate circle.

(iv) Mark should be dark and completely fill the circle.

(v) Dark only one circle for each entry.

(vi) Dark the circle in the space provided only.

(vii) Rough work must not be done on the Answer sheet and do not use white-fluid or any other rubbing material on the Answer sheet.

PHYSICS

SECTION-A

Choose the correct answer:

1. Identify the vector quantity among the following

(1) Distance   (2) Heat   (3) Angular momentum (4) Energy

2. Distance travelled by a particle starting form rest and moving with an acceleration of $\frac{4}{3}\,\text{ms}^{-2}$, in the second is

(1) $\frac{10}{3}\,\text{m}$ (2) $\frac{19}{3}\,\text{m}$ (3) 4 m   (4) 6 m

3. A ball is projected vertically up with an initial velocity. Which of the following graph represent KE of ball?
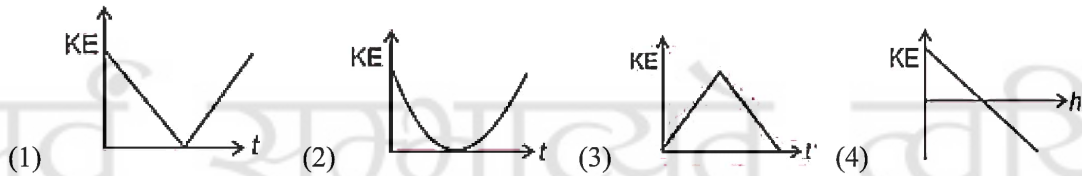
4. A ball is projected from ground at angle θ with the horizontal. After t = 1 s, it is moving at 45° with the horizontal and after t = 2 second, it is moving horizontally. What is speed of projection of ball? [g = 10 m s^{-2}]

(1) $10\sqrt{2}$ m/s   (2) $10\sqrt{3}$ m/s   (3) 20 m/s   (4) $10\sqrt{5}$ m/s

5. In the equation of angular displacement of a particle moving on a circular path is given as $\theta = 2t^3 + 0.5$, θ is in radian and t in second. The θ angular velocity of the particle at t = 2 s is

   (1) 16.5 rad/s   (2) 19.5 rad/s   (3) 24 rad/s   (4) 12 rad/s

6. Bullets of 0.03 kg mass each hit a plate at a rate of 200 bullets per second with velocity of 50 m/s and reflect back with velocity of 30 m/s. The average force acting on the plate in newton is

   (1) 120   (2) 180   (3) 480   (4) 245

7. A block rests on an inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between block and the plane is 0.8. If the frictional force on the block is 10 N, then mass of block (in kg) (Take g = 10 m/s^2)

   (1) 2.0   (2) 2.5   (3) 4.0   (4) 1.5

8. A mass of 1 kg is suspended by a thread. It is lifted up with an acceleration of 4.9 ms^{-2}, and then lowered with an acceleration of 4.9 ms^{-2} . The ratio of tensions in first case to second cases is (g = 9.8 ms^{-2})

   (1) 2 : 1   (2) 1 : 1   (3) 3 : 1   (4) 1 : 3

9. A particle moves along x axis from x = 1 m to x = 3 m under the effect of the force F = 3x^2 – 2x + 5 N. Work done in process is

   (1) 24 J   (2) 38 J   (3) 18 J   (4) 28 J

10. In stable equilibrium position, a body has

    (1) Maximum potential energy

    (2) Minimum potential energy

    (3) Minimum kinetic energy

    (4) Neither maximum nor minimum potential energy

11. Two bodies of mass 10 kg and 2 kg are moving with velocities $(2\hat{i} - 7\hat{j} + 3\hat{k})$ m/s and $(-10\hat{i} + 5\hat{j} - 3\hat{k})$ m/s respectively. The velocity of their centre of mass is

    (1) $2\hat{i}$ m/s   (2) $2\hat{k}$ m/s   (3) $4\hat{i} + 2\hat{j}$ m/s   (4) $6\hat{i} + 2\hat{j} - 3\hat{k}$ m/s

12. A flywheel of mass 50 kg and radius of gyration about its axis of rotation of 0.5 m is acted upon by a constant torque of 12.5 N m. Its angular velocity at t = 5 s is

    (1) 2 rad/s   (2) 5 rad/s   (3) 10 rad/s   (4) 12 rad/s

13. A body is released from height equal to radius R of the earth. The velocity of body with which it will strike the earth surface is

    (1) $\sqrt{2gR}$ (2) $2\sqrt{gR}$ (3) $\sqrt{gR}$ (4) $\sqrt{\dfrac{gR}{2}}$

14. The height at which the weight of an object becomes $\left(\dfrac{1}{16}\right)^{th}$ of its weight on the surface of earth is (R is radius of earth)

    (1) 3 R   (2) 2 R   (3) 4 R   (4) 5 R

15. A wire can be broken by a load of 20 kg-wt. The force required to break wire of same material with twice the diameter will be

    (1) 20 kg-wt   (2) 60 kg-wt   (3) 90 kg-wt   (4) 80 kg-wt

16. If work done in increasing the size of rectangular soap film with dimensions 8 cm × 3.75 cm to 10 cm × 6 cm is 2×10^{-4} J. The surface tension of film in newton per meter is

    (1) 2.1×10^{-2} (2) 1.65×10^{-2} (3) 3.3×10^{-2} (4) 4.2×10^{-2}

17. Two rain drops reach earth from clouds with different terminal velocities having ratio 9 : 4. Then the ratio of their volumes is

    (1) 3 : 2   (2) 27 : 8   (3) 64 : 81   (4) 8 : 27

18. In a thermodynamic process, pressure of fixed mass of a gas is changed in such a manner that the gas releases 20 J of heat and 8 J of work is done on the gas. If initial internal energy of the gas was 40 J, what will be final internal energy?

    (1) 18 J   (2) 28 J   (3) 52 J   (4) 32 J

19. Choose the correct statement.

    (1) Internal energy is a path function, while heat is not

    (2) Heat is a path function, while internal energy is not

    (3) Both heat and internal energy are not path function

    (4) Both heat and internal energy are path function

20. An ideal engine whose efficiency is 40%, receives heat at 500 K. If required efficiency is 50%, then intake temperature for the same exhaust temperature is

    (1) 800 K   (2) 700 K   (3) 400 K   (4) 600 K

21. The root mean square speed of molecules of a gas is 1260 m/s. The average speed of the gas molecules is

    (1) 1161 m/s   (2) 1671 m/s   (3) 912 m/s   (4) 1040 m/s

22. An object on a spring vibrates in a simple harmonic motion at a frequency of 4 hertz and an amplitude of 8 cm. If the mass of the object is 200 g, the spring constant is

    (1) 40 N/m   (2) 160 N/m   (3) 126 N/m   (4) 109 N/m

23. A heavy rope is suspended from rigid support. A wave pulse is set up at the lower end. Then

    (1) The pulse travels with uniform speed   (2) The pulse will travel with increasing speed

    (3) The pulse will travel with decreasing speed   (4) The pulse cannot travel through rope

24. Two waves of wavelength 50 cm and 51 cm produced 12 beats per second. The velocity of sound is

   (1) 306 m/s   (2) 333 m/s   (3) 342 m/s   (4) 356 m/s

25. A positive charge is moved from low potential point A to a high potential point B. Then the electric potential energy

   (1) Increases   (2) Decreases

   (3) Will remain same   (4) Nothing definite can be predicted

26. A parallel plate capacitor is charged and then charging battery is disconnected. If the plates are now pulled apart with insulated handles

   (1) The capacitance increases

   (2) Potential energy decreases

   (3) Potential difference increases

   (4) Charge and potential difference both remains same

27. In the shown circuit, current through 4 Ω resistor is
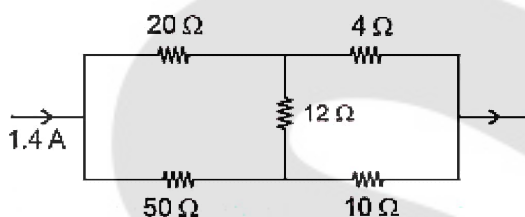
   (1) 0.6 A   (2) 0.7 A   (3) 1 A   (4) 1.2 A

28. Two identical cells connected in series send 10 A current through a 5 Ω resistor. When they are connected in parallel, they send 8 A current through same resistance. What is internal resistance of each cell?

   (1) 2.5 Ω   (2) 1 Ω   (3) 1.5 Ω   (4) 1.9 Ω

29. Three long wires, carrying current 10 A, 20 A and 30 A are placed parallel to each other as shown. Point P and Q are in midway of wires. What is ratio of magnetic field at P to the Q?
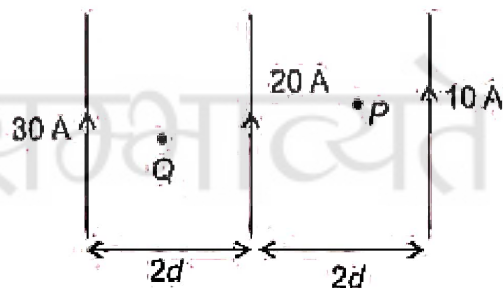
   (1) 2 : 1   (2) 3 : 2   (3) 2 : 3   (4) 3 : 1

30. A 0.8 m long solenoid has 800 turns and has a field density of 2.52×10^{-3} T at its centre. What is current in the wire?

(1) 3 A   (2) 2 A   (3) 1 A   (4) 4 A

31. A charge particle having charge 2 C is thrown with velocity of $(2\hat{i}+3\hat{j})$ m/s inside a region having $\vec{E}=2\hat{j}$ N/C and magnetic field $5\hat{k}$ T. The Lorentz force acting on particle is

(1) $(30\hat{i}-16\hat{j})N$ (2) $(15\hat{i}+20\hat{j})N$ (3) $(15\hat{i}-30\hat{j})N$ (4) $(30\hat{i}+15\hat{j})N$

32. The relative permeability of iron is 5500. What is its magnetic susceptibility?

(1) 1   (2) 5499   (3) 5501   (4) 4999

33. The resistance of a silicon junction diode, whose V - I characteristics is as shown in figure is (V_k = 0.7 V)

(1) 0.2 kΩ (2) 0.1 kΩ (3) 1.5 kΩ (4) 3.7 kΩ
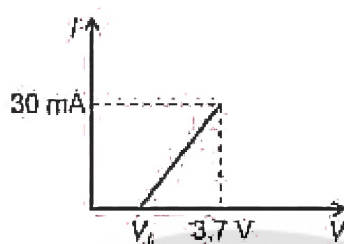
34. The horizontal component of earth's magnetic field at a place is 4×10^{-4} T and dip is 45°. A metal rod of length 20 cm is placed in north south direction and is moved at constant speed of 5 cm/s towards East. What is e.m.f. induced in the rod?

(1) 4×10^{-6} V   (2) 2×10^{-4} V   (3) 4×10^{-5} V   (4) 3×10^{-6} V

35. According to Lenz's law of electromagnetic induction

(1) The induced emf in the direction opposing the change in magnetic flux

(2) The relative motion between coil and magnet produces no change in magnetic flux in any case

(3) Only magnet should be moved towards coil

(4) Only the coil should be moved towards magnet

SECTION-B

36. A coil has resistance of 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source of 200 V, 100 Hz is connected across the coil, current in coil will be

(1) 2 A   (2) 4 A   (3) 5 A   (4) 6 A

37. A plane electromagnetic wave EZ = 100 cos (6×10^8 t + 4x) V/m, where x is in metre and t is in second. propagates in medium, what is refractive index of the medium?

(1) 1.2   (2) 2.0   (3) 1.4   (4) 1.5

38. If two coherent waves are represented by $y_1 = 4\sin \omega t$ and $y_2 = 3\sin(\omega t + \pi/3)$ interfere at a point, the amplitude of resulting wave will be about

(1) 7.2   (2) 6.1   (3) 5   (4) 12

39. The fringe width in Young's double slit experiment increases when

    (1) Wavelength decreases

    (2) Distance between sources and screen decreases

    (3) Source slit is moved closer to slit openings

    (4) Distance between slits plane and screen increases

40. A defective eye cannot see close objects clearly because their image is formed

    (1) On the eye lens   (2) Between eye lens and retina

    (3) On the retina   (4) Beyond retina

41. Rainbow is formed due to

    (1) Scattering and refraction   (2) Scattering and reflection

    (3) Internal reflection and dispersion   (4) Dispersion alone

42. When light of maximum wavelength 300 nm falls on a photoelectric emitter, photoelectrons are liberated. For another emitter however light of maximum wavelength 600 nm causes photoelectric emission. The ratio of work functions of first emitter to second emitter will be

    (1) 1 : 2   (2) 2 : 1   (3) 1 : 1   (4) 1 : 4

43. The Boolean equation for the circuit as shown in figure is

    (1) A·B   (2) $\overline{A}+B$ (3) $\overline{A}$ B   (4) A + B

44. After one alpha particle emission and one β^- particle emission from a nucleus

    (1) Mass number reduces by 5   (2) Atomic number increases by 1

    (3) Mass number reduces by 2   (4) Atomic number reduces by 1

45. To measure light intensity we use

    (1) LED with forward bias   (2) LED with reverse bias

    (3) Photodiode with forward bias   (4) Photodiode with reverse bias

46. Two trains 101 m and 99 m in length are running in opposite direction with velocities 54 km/h and 36 km/h. In what time they will completely cross each other?

    (1) 20 s   (2) 8 s   (3) 10 s   (4) 16 s

47. A body of mass M is rotating in a vertical circle of radius r with critical speed. The difference in its kinetic energy at the top and the bottom is

    (1) 2 Mgr   (2) 4 Mgr   (3) 6 Mgr   (4) 3 Mgr

48. The angular frequency of a simple pendulum is ω rad/s. Now the length is made one fourth of the original length, the angular frequency becomes

(1) $\dfrac{\omega}{2}$ (2) 2ω (3) 4ω (4) ω

49. The radii of circular orbits of two satellites A and B of the earth, are 4R and R, respectively. If speed of satellite A is 2V, then the speed of satellite B will be

(1) 2V   (2) $\dfrac{V}{2}$ (3) 4 V   (4) $\dfrac{V}{4}$

50. If the distance between successive compressions and rarefaction in a sound wave is 2 m and velocity of sound is 360 m/s, then the frequency is

(1) 180 Hz   (2) 45 Hz   (3) 120 Hz   (4) 90 Hz

CHEMISTRY

SECTION-A

Choose the correct answer:

51. 21.75 g of MnO_2 on reaction with HCl forms 2.8 L of $Cl_2(g)$ at STP, the percentage purity of MnO_2 is (atomic mass of Mn = 55u)

$$MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$$

(1) 80%   (2) 75%   (3) 33%   (4) 50%

52. Which of the following has the maximum number of electrons?

(1) 14 g of N^{3-} ion   (2) 4 g of Ca^{2+} ion   (3) 16 g of O_3 (4) 2.3 g of Na^+ ion

53. The radii of 2nd Bohr orbit of Be^{3+} ion is

(1) 26.45 pm   (2) 52.9 pm   (3) 79.35 pm   (4) 105.8 pm

54. For hydrogen atom, the correct order of energy of orbitals is

(1) 4f > 4d > 4p > 3d > 3p > 3s   (2) 4f = 4d > 3d > 4p > 3p > 3s

(3) 4f > 4p > 4d = 3d > 3p > 3s   (4) 4f = 4d = 4p > 3d = 3p = 3s

55. If the value of ionisation enthalpy of K is x eV then the value of electron gain enthalpy of K^+ is

(1) –x eV   (2) –2x eV   (3) +2x eV   (4) $-\dfrac{1}{2} \times eV$

56. The correct order of ionic radii is represented in

(1) $O > O^- > O^{2-}$ (2) $Al^+ > Al^{2+} > Al^{3+}$ (3) $S^{2-} > K^+ > Cl^-$ (4) $Mg^{2+} > Na^+ > N^{3-}$

57. Which of the following pairs of compounds are isostructural?

(1) H_2O and SO_3 (2) I_3^- and XeF_2 (3) NH_3 and BF_3 (4) SF_4 and XeF_4

58. The species which does not exist is

(1) Li_2 (2) C_2 (3) H_2 (4) He_2

59. The number of σ and π bonds in the following compound respectively are

$$CH_2 = CH - \overset{\overset{O}{\|}}{C} - CH_2 - CN$$
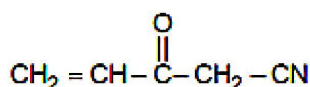
(1) 12 and 3   (2) 11 and 3   (3) 12 and 4   (4) 11 and 4

60. The temperature at which rms velocity of CH_4 will be same as that of O_2 at 27ºC is

(1) 150 K   (2) 450 K   (3) 600 K   (4) 900 K

61. van der Waals constant (a) for the gases A, B, C and D are 1.25, 3.29, 4.28 and 0.244 respectively. The gas which is most easily liquefied is

(1) A   (2) B   (3) C   (4) D

62. For the reaction, $CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)$ at constant temperature, $\Delta H - \Delta E$ is

(1) –RT   (2) RT   (3) –2RT   (4) 2RT

63. Four monobasic acids A, B, C and D have their respective $\Delta_{neut}H°°$ values as − 11.5, −7.5, − 12.4 and − 8.9 kcal/mol. Which of the following acids has the highest pKa value?

(1) A   (2) B   (3) C   (4) D

64. For the reversible reactions,

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

Which of the following does not affect the equilibrium state?

(1) Increase in the volume of the container   (2) Decrease in the volume of the container

(3) Addition of CaO(s)   (4) Addition of inert gas at constant pressure

65. Conjugate acid and conjugate base of HPO_4^{2-} respectively are

(1) $H_2PO_4^-$ and H_3PO_4 (2) $H_2PO_4^-$ and PO_4^{3-}

(3) H_2PO_4 and PO_4^{3-} (4) PO_4^{3-} and $H_2PO_4^-$

66. Which of the following is not a disproportionation reaction?

(1) $Cl_2 + OH^- \longrightarrow Cl^- + ClO_3^- + H_2O$ (2) $P_4 + OH^- + H_2O \longrightarrow PH_2 + H_2PO_2^-$

(3) $S_8 + OH^- \longrightarrow 4S^{2-} + 2S_2O_3^{2-} + 6H_2O$ (4) $F_2 + OH^- \longrightarrow F^- + OF_2 + H_2O$

67. The oxidation state of central bromine atom in Br_3O_8 is

(1) +6   (2) +3   (3) +4   (4) +5

68. Which of the following is a method of laboratory preparation of dihydrogen?

(1) Electrolysis of acidified water using platinum electrodes

(2) Reaction of granulated zinc with dil hydrochloric acid

(3) Reaction of steam on hydrocarbons or coke at high temperature in the presence of catalyst

(4) Electrolysis of brine solution

69. The characteristic colour exhibited by Rb atom to an oxidizing flame is

    (1) Crimson red   (2) Yellow   (3) Red violet   (4) Blue

70. The 13th group element which has the least melting point is

    (1) B   (2) Al   (3) Ga   (4) In

71. Thermodynamically, the most stable allotrope of carbon is

    (1) Coke   (2) Fullerene   (3) Diamond   (4) Graphite

72. Formic acid on reaction with concentrated H_2SO_4 at 373 K gives

    (1) CO_2 (2) HCHO   (3) CH_3OH (4) CO

73. Kjeldahl's method is applicable to which of the following compounds?
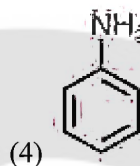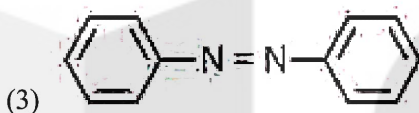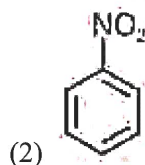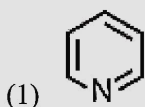
74. The compound which is most reactive towards electrophilic substitution reaction is
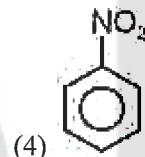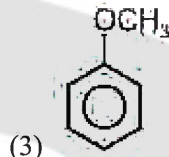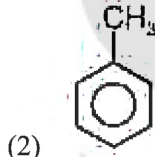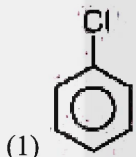
75. Which of the following pairs of compounds are metamers of each other?
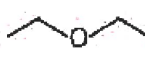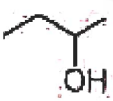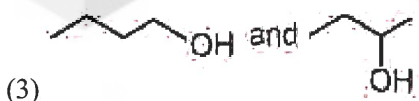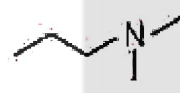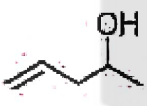
76. Ethene on reaction with Baeyer's reagent gives
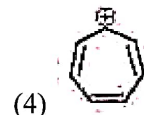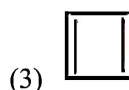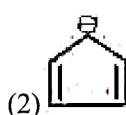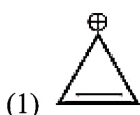
    (1) Ethane-1, 2 diol   (2) Ethanoic acid   (3) Ethanal   (4) Ethanol

77. Anti-aromatic species among the following is

78. Maximum prescribed concentration of Cd in drinking water is

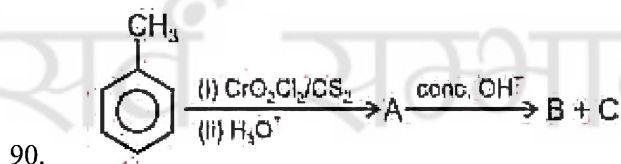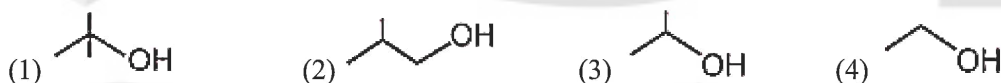   (1) 0.2 ppm   (2) 0.02 ppm   (3) 0.005 ppm   (4) 0.05 ppb
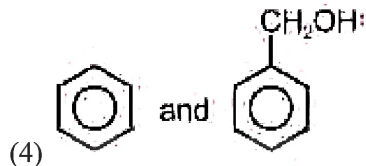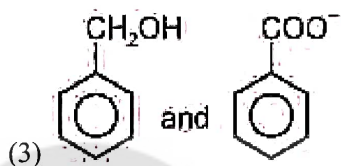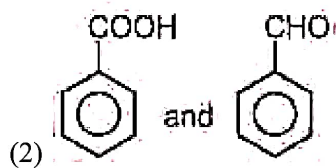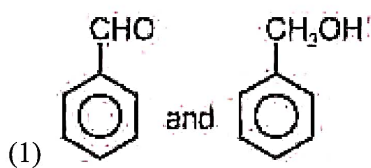
79. Packing efficiency of fcc unit cell is

    (1) 74%　　　　　　(2) 68%　　　　　　(3) 52.8%　　　　　　(4) 26%

80. Which of the following colligative property is used to determine molar masses of proteins?

    (1) Relative lowering of vapour pressure　　　(2) Elevation in boiling point

    (3) Depression in freezing point　　　(4) Osmotic pressure

81. Which of the following metal has the highest conductivity at room temperature?

    (1) Na　　　　　　(2) Cu　　　　　　(3) Ag　　　　　　(4) Au

82. Which of the following quantities changes on addition of a catalyst during a chemical reaction?

    (1) Equilibrium constant　(2) Activation energy　(3) Gibbs energy　　(4) Enthalpy

83. For the coagulation of methylene blue sol, the flocculating power of which of the following ion is maximum?

    (1) PO_4^{3-}　　　　(2) Al^{3+}　　　　(3) Cl^-　　　　(4) Ba^{2+}

84. Select the incorrect statement about electrolytic refining

    (1) Impure metal is made to act as anode　　　(2) Pure metal is used as cathode

    (3) Zinc can be refined using this method　　　(4) Impurities deposit as cathode mud

85. The compound which has the highest reducing character among the following is

    (1) H_2O　　　　　(2) H_2S　　　　　(3) H_2Se　　　　　(4) H_2Te

SECTION-B

86. The ion which has the highest magnetic moment is

    (1) Sc^{3+}　　　　(2) Ni^{2+}　　　　(3) Ti^{3+}　　　　(4) Zn^{2+}

87. The co-ordination complex which shows linkage isomerism is

    (1) $[Co(NH_3)_5NO_2]^{2+}$　(2) $[Co(NH_3)_6]^{3+}$　(3) $[Co(NH_3)_5Br]^{2+}$　(4) $[Cr(H_2O)_5Cl]^{2+}$

88. The alkyl halide which is most reactive towards dehydrohalogenation is

    (1) R-F　　　　　　(2) R-Cl　　　　　　(3) R-Br　　　　　　(4) R-I

89. The alcohol which reacts fastest with Lucas reagent is


90.

    B and C are

(1) CHO and CH₂OH (benzene ring structures)

(2) COOH and CHO (benzene ring structures)

(3) CH₂OH and COO⁻ (benzene ring structures)

(4) CH₂OH (benzene ring structures)

91. Consider the following reaction sequence,

Major product D is

(1) $CH_3CH_2NH_2$
(2) $CH_3CH_2CONH_2$
(3) $CH_3CH_2CH_2NH_2$
(4) $CH_3CH=NH$

92. Nitrobenzene on reduction with $LiAlH_4$ in the presence of ether yields

$$CH_3CH_2Cl \xrightarrow{KCN} A \xrightarrow{H_3O^+} B \xrightarrow{NH_3/\Delta} C \xrightarrow{Br_2+NaOH} D$$
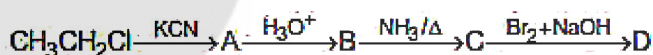
(1) Hydrazobenzene
(2) Azoxybenzene
(3) Azobenzene
(4) p-amino phenol

93. Purine base among the following is

(1) Cytosine
(2) Guanine
(3) Thymine
(4) Uracil

94. Monomer of Nylon-6 is

(1) Acrylonitrile
(2) Styrene
(3) Caprolactam
(4) Chloroprene
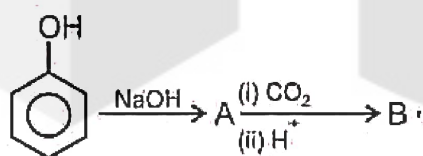
95. Antidepressant drug among the following is

(1) Phenelzine
(2) Chloramphenicol
(3) Prontosil
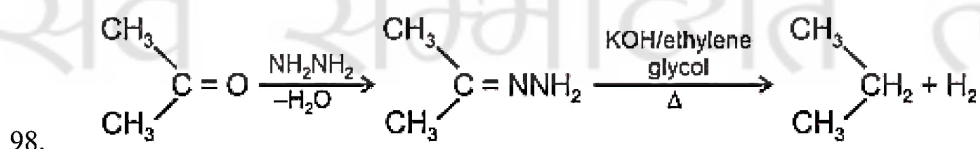(4) Salvarsan

96. Number of P-OH bonds in pyrophosphoric acid is

(1) 1
(2) 2
(3) 3
(4) 4

97. Consider the following reaction,

$$OH \xrightarrow{NaOH} A \xrightarrow[(ii)\ H^+]{(i)\ CO_2} B$$

The major product (B) obtained in the above reaction is

(1) Salicylaldehyde
(2) Salicylic acid
(3) Benzoic acid
(4) Phthalic acid

98.

$$\underset{CH_3}{\overset{CH_3}{>}}C=O \xrightarrow[-H_2O]{NH_2NH_2} \underset{CH_3}{\overset{CH_3}{>}}C=NNH_2 \xrightarrow[\Delta]{KOH/ethylene\ glycol} \underset{CH_3}{\overset{CH_3}{>}}CH_2 + H_2$$

The above reaction is known as

(1) Rosenmund reduction
(2) Clemmensen reduction

(3) Wolff-Kishner reduction
(4) Stephen reaction

99. If the standard electrode potential for a cell $A^{2+}(aq) + 2B(s) \rightarrow A(s) + 2B^{+}(aq)$ is 1.9 V, then the standard Gibbs energy for the reaction is

(1) 3.8 F J/mol   (2) –1.9 F J/mol   (3) –3.8 F J/mol   (4) –7.6 F J/mol

100. Most basic compound among the following is

(1) La(OH)$_3$ (2) Eu(OH)$_3$ (3) Er(OH)$_3$ (4) Lu(OH)$_3$